



Available Resources

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LTMO

State of the Union

- LTMO tools & approaches still developing
 - Almost no comparative evaluations of techniques exist
 - One exception: EPA/AFCEE sponsored demonstration of MAROS and 3-Tiered Approach
- Optimization often broadly defined
 - Guidance, resources do not always define LTMO in same way or discuss same concepts
 - Smaller subset of resources more narrowly focused on *physical program* optimization
 - Monitoring points, sampling events

Types of Information

- Published guidance, monographs
- Case studies
- Specific LTMO approaches
- Web sites

Guidance

- Navy
 - *Department of the Navy Policy for Optimizing Remedial and Removal Actions Under the Environment Restoration Programs, Apr 2004*
 - *Guide to Optimal Groundwater Monitoring, Jan 2000*

Guidance (cont.)

- Air Force (AFCEE)
 - *Final Remedial Process Optimization Handbook prepared for the Air Force Center for Environmental Excellence and the Defense Logistics Agency, June 2001*
 - *Long-Term Monitoring Optimization Guide, Final Version 1.1, Oct 1999*

Guidance (cont.)

- Dept. of Energy
 - *Technical Guidance for the Long-Term Monitoring of Natural Attenuation Remedies at Department of Energy Sites, Oct 1999*

Monographs

- *Long-Term Groundwater Monitoring-The State of the Art, 2003*
 - Barbara Minsker, Editor, ASCE
 - Also includes case study summaries
- *Roadmap to Long-Term Monitoring Optimization, 2005*
 - EPA, USACE
- *Review of ground-water quality monitoring network design (Loaiciga, et al)*
 - Journal of Hydraulic Engineering, 1992

Case Studies

- *Demonstration of Two Long-Term Groundwater Monitoring Optimization Methods – Report with Appendices, July 2004*
 - USEPA OSWER
 - <http://clu-in.org/download/char/542-r-04-001b.pdf>
- *Long-Term Groundwater Monitoring-The State of the Art, 2003*
 - Barbara Minsker, Editor, ASCE
- *Federal Remediation Technologies Roundtable Optimization Case Study Search*
 - <http://costperformance.org/optimization/search.cfm>

Specific Approaches

- Cost-Effective Sampling (CES)
- MAROS
- Three-Tiered Approach
- GTS

Cost-Effective Sampling (CES)

- Contact: Maureen Ridley, Lawrence Livermore, ridley1@llnl.gov
 - *Sampling plan optimization: a data review & sampling frequency evaluation process* (Ridley & MacQueen)
 - Groundwater Monitoring & Remediation, 2004
 - *Cost-Effective Sampling of Groundwater Monitoring wells: A Data Review & Well Frequency Evaluation* (Ridley & MacQueen)
 - Lawrence Livermore library (online)
 - <http://www-erd.llnl.gov/library/JC-118909.pdf>

MAROS

- Contact: Mindy Vanderford, Groundwater Services, Inc., mvanderford@gsi-net.com
 - *MAROS: A decision support system for optimizing monitoring plans* (Aziz, et al)
 - Ground Water, 2003
 - *Strategies & decision-support tools for optimizing long-term groundwater monitoring plans — MAROS 2.0* (Ling, et al)
 - Bioremediation Journal, 2004

Three-Tiered Approach

- Contact: Carolyn Nobel, Parsons Engineering, carolyn.nobel@parsons.com
 - *A three-tiered approach to long term monitoring program optimization* (Nobel & Anthony)
 - Bioremediation Journal, 2004
 - *Three-Tiered Approach to Long Term Monitoring Optimization Workshop*
 - Conference on Accelerating Site Closeout, Improving Performance, and Reducing Costs Through Optimization, June 2004

GTS

- Contact: Kirk Cameron, MacStat Consulting, Ltd., kcmacstat@qwest.net
 - Better optimization of long-term monitoring networks (Cameron)
 - Bioremediation Journal, 2004
 - *Using spatial models and kriging techniques to optimize long-term ground-water monitoring networks: a case study* (Cameron & Hunter)
 - Environmetrics, 2002

Web Sites

- *EPA “Clu-In” Remediation Optimization Page*
 - <http://www.cluin.org/optimization>
- *AFCEE Environmental Restoration Products Page*
 - <http://www.afcee.brooks.af.mil/products/rpo/default.asp>
- *Navy & Marine Corps Working Group Optimizing Remedial Action Operations & Long Term Monitoring Website*
 - http://enviro.nfesc.navy.mil/erb/support/work_grp/raoltm/main.htm

Web Sites (cont.)

- *Federal Remediation Technologies Roundtable Monitoring Optimization Webpage*
 - <http://www.frtr.gov/optimization/monitoring.htm>
- *Conference on Accelerating Site Closeout, Improving Performance, and Reducing Costs Through Optimization*
 - <http://clu-in.org/siteopt/ataglance.htm>

In Conclusion

- Only selected resources highlighted here
 - Other excellent papers referenced in guidance and monographs
 - LTMO Roadmap appendix
- Though techniques still evolving, enough resources exist to:
 - Gain an overview of LTMO possibilities
 - Allow planning for future LTMO efforts